Milwaukee School of Engineering

Bulletin

RADIO AND TELEVISION ISSUE

CALENDAR

Fall Term 1950

Registration, new and advanced	Sept. 22-Oct. 2
Classes begin at 7:45 a.m.	Mon. Oct. 2
Thanksgiving Recess begins at 9:55 p.m.	Wed. Nov. 29
Classes resume at 7:45 a.m.	Mon. Dec. 4
Examinations begin	Mon. Dec. 18
End of Fall Term, 9:55 p.m.	Fri. Dec. 22

Winter Term 1950

Registration, new and advanced	Dec. 26-Jan. 8
Classes begin at 7:45 a.m.	Mon. Jan. 8
Examinations begin	Mon. Mar. 26
End of Winter Term, 9:55 p.m.	Fri. Mar. 30

Spring Term 1951

Registration, new and advanced	Mar. 26-Apr. 2
Classes begin at 7:45 a.m.	Mon. Apr. 2
Memorial Day Recess	Wed. May 30
Examinations begin	Mon. June 18
End of Spring Term, 9:55 p.m.	Fri. June 22

Summer Term 1951

Registration, new and advanced	June 22-July 2
Classes begin at 7:45 a.m.	Mon. July 2
Fourth of July Recess	Wed. July 4
Labor Day Recess	Mon. Sept. 3
Examinations begin	Mon. Sept. 17
End of Summer Term	Fri. Sept. 21

Fall Term 1951

Registration, new and advanced	Sept. 21-Oct. 1
Classes begin at 7:45 a.m.	Mon. Oct. 1
Thanksgiving recess begins 9:55 p.m.	Wed. Nov. 28
Classes resume 7:45 a.m.	Mon. Dec. 3
Examinations begin	Mon. Dec. 17
End of Fall Term, 9:55 p.m.	Fri. Dec. 21

VOLUME 2 SEPTEMBER 10, 1950 NUMBER 11

The Milwaukee School of Engineering Bulletin is published by the Milwaukee School of Engineering's Division of Public Relations, Milwaukee 1, Wisconsin; issued semi-monthly during the months of February to July inclusive, and three times a month during the months of August to January inclusive. Entered as second class matter January 7, 1949 at the post office at Milwaukee, Wisconsin, under the Act of August 24, 1912.

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MSOE...

A Part of Modern Industry

Never before in the history of the world has a country experienced such a period of rapid technological growth as did American industry in the past fifty years. The automobile, airplane, electric washing machine, radio, television, electric refrigeration, automatic heating, air conditioning, etc., all of which we today take for granted, were either as yet not invented or little known at the turn of the century. Naturally, this growth opened many new fields of employment. However, few men with an adequate combination of technical training and formal education were available to supply the requirements of these new occupational opportunities. Industry's need for technically trained specialists initiated the development of programs of technical training which could prepare men to meet the challenge of this great technological era.

Founded 1903

Among the schools founded to meet the need was the School of Engineering of Milwaukee, which was established in 1903. The late Oscar Werwath, founder, a practicing engineer, physicist and humanitarian, was called upon to privately train groups from industry. Recognizing industry's need, Mr. Werwath set about the building of a staff and the assembling of equipment for instructional purposes. His philosophies and educational techniques were responsible for the School's steady growth, in both breadth of services rendered and area served. By 1932 the School had become a non-profit, quasi-public institution with world-wide enrolment.

Industry Cooperates

Leaders of industry and commerce offered Mr. Werwath much cooperation in the School's development. They helped with the realization that future productivity and stability of industry depends on educational agencies which can recruit men from the ranks of the untrained, and prepare them properly for positions of technical, commercial and administrative responsibility.

Eminent as a pioneer and as an international leader in the field of technical education, the Milwaukee School of Engineering offers courses of instruction which are flexible so as to meet new trends and developments, but it has not modified its prime objective — to educate and to train men for careers in industry and to advance scientific knowledge.

THE INSTITUTE OF ELECTROTECHNICS

Radio and Television Technician Section

F. J. VAN ZEELAND, *Director*

E. W. HASSEL, *Head*
ELECTRONICS BRANCH

W. A. VAN ZEELAND, *Head*
RA/TEL TECHNICIAN SECTION

A. C. DANIELSEN, *Manager*
CENTRAL LABORATORY

B. ARNESON,
RADIO SERVICING

R. BANKER
CIRCUIT THEORY

J. DORSEY
CIRCUIT LAB.

P. ZUBLER
TRANSMITTERS

Department Heads

A. JONES
MATHEMATICS

A. HERRMANN
ENGLISH

E. PETTY
DRAFTING

L. STOCKLAND
PHYSICS

MSOE Trains Industrial Leaders for the World

When the Milwaukee School of Engineering was founded, nearly a half century ago, the electrical industry and its allied fields were in their infancy. It has pioneered in the introduction of technical curricula which has kept pace with technological developments in the fields it embraces. From all of the 48 states and 23 foreign countries and American territories, the current enrolment of 1,555 students well illustrates the scope of the School's reputation.

Student life at the Milwaukee School of Engineering is stimulating, pleasant and democratic. The highly specialized character of the programs attracts men of particular interest and experience from a broad geographic distribution. These men live closely together in classes and in their extra-curricular activities. They represent a broad variation in racial, national and colloquial background and assemble from a wide range of educational patterns and industrial, commercial and military experience. The student body is characterized, therefore, by purposeful men attentive to their responsibilities, sufficiently mature to provide an accomplishing atmosphere for learning.

The Concentric Curriculum

The MSOE Concentric Curriculum program of education offers specific benefits to the student. The complete curriculum is designed in a multiple of units or courses, each of which prepares the student for an educational level with specific job objectives (see Occupational Chart on page 22) while at the same time he is preparing himself for completion of the entire program. Certificates or degrees are awarded upon completion of each level. Thus, if the student is forced to leave school because of illness, financial difficulties, or other reasons, before completing the entire program, he has acquired knowledge which will enable him to earn a living commensurate with his level of achievement.

Tailored to the Times

The School cooperates closely with industry on an international basis and maintains a flexible curriculum so that it can readily introduce the latest results of industrial research, as well as the School's, into its courses of study. This combination of knowledge of new developments in industry and the consequent adoption of these developments into the courses concerned, has played no small part in maintaining the Milwaukee School of Engineering's world-wide reputation as a leader in the field of technical education.

Milwaukee School of Engineering alumni in the United States and throughout the world have taken their places as leaders in research, manufacturing, sales, executive, and maintenance positions in industry. These engineers and technicians have been instrumental in the tremendous technological development of our modern world.

General Information

Organization of the School

The Milwaukee School of Engineering is a non-profit educational institution incorporated under the laws of the State of Wisconsin. It is the purpose of the School to present courses in engineering and technical subjects. The School has the authority by charter of the State of Wisconsin to confer appropriate certificates and degrees. It is organized as a non-profit, non-stock corporation operated by a governing Board of Regents, composed of leaders in commerce and industry. Members of the Board of Regents are elected from among members of the corporation.

Accreditation

The School is a charter member of the National Council of Technical Schools which approves its technical institute-type curricula. The technician courses are accredited by the Engineers' Society for Professional Development, national accrediting body for engineering education. The School is authorized by the State of Wisconsin to confer appropriate certificates and degrees upon its graduates and is a member of the Technical Institute Division of the American Society for Engineering Education. A student chapter of the American Institute of Electrical Engineers was established at the School in 1919.

Industrial Advisors

The School's educational program is closely geared to the latest manpower needs of industry through the constant advice and recommendation of the Industrial Advisory Committees of the School. There is an advisory committee for each division. These committees are composed of men of outstanding ability and achievement in commerce and industry. Through regular meetings of these committees, recommendations on subjects and over-all development of courses are made. In this manner MSOE curricula are kept constantly up-to-date that a student receives the latest in technical development and techniques.

Facilities

Instructional facilities in the Main Building are supplemented by use of a modern building containing laboratories of the Refrigeration, Heating and Air Conditioning Institute, a new building containing machine shops and laboratories, and a central building containing lecture rooms and a sizable auditorium. MSOE boasts of some of the country's best equipped laboratories. A student Book Store, Cafeteria, and Library are all located in the Main Building.

The School Year

Four quarters of twelve weeks each make up the school year. Thus the schedule is arranged for forty-eight of the fifty-two weeks of the calendar year. The vacations are scheduled to offer rest in periodic divisions in harmony with the accepted holiday calendar. New classes are formed at the opening of each quarter, and students may be accepted at any quarter.

Admissions

SERVICE COURSE — There are no formal entrance requirements for admission to the Practical Electricity Course. Recommendations for admission are made by the Registrar. This course serves as a preparatory program for the potential technician or engineering student who requires background to remove deficiencies or who wishes to review basic subjects.

TECHNICIAN COURSE — Admission to the semi-professional technician course in Radio and Television is by one of the following methods: by transcript indicating graduation from an approved secondary school; by transfer and admission with advanced standing from a similar school of higher learning; by successful completion of the Practical Electricity Course offered by the Milwaukee School of Engineering; by entrance examination, since formal credit is not the only evaluation of academic accomplishment; with deficiencies, students who otherwise qualify but lack academic level may, upon recommendation of the Registrar, be admitted with deficiencies.

CREDIT FOR PREVIOUS TRAINING — Advance credit is granted at the time of registration in all subjects in which it can be established that the prospective student has knowledge of the subject. This knowledge may have been gained through previous practical, military or academic training or experience.

FOR FURTHER INFORMATION — The Annual Catalog issue of the Milwaukee School of Engineering Bulletin contains complete information on the School, its curricula, subjects of instruction, and student services. To obtain a copy (for which there is no charge) paste the coupon from page 24 on a postal card or put it in an envelope addressed to: THE DIRECTOR OF ADMISSIONS, Milwaukee School of Engineering, Milwaukee 1, Wisconsin.

Specify the program in which you are particularly interested.

Tuition

Tuition and fees are payable by the term according to the following schedule:

Basic Tuition for a Service Course _____ per term $150.00
Practical Electricity

Basic Tuition for a Technician Course _____ per term $125.00
Radio and Television Technician

Tuition, as quoted, includes laboratory expenses for the stated periods. For additional information see the School Catalog.

The Faculty

The School's faculty of 85 includes technical specialists and teachers of related subjects and the humanities. Those in the technical fields have, to a great extent, augmented their formal study with actual industrial experience in their particular fields.

Student Services

COUNSELING — Through counseling and testing, the School contributes to the well-being of students both in their academic work and in life generally by helping them analyze and solve their individual problems. Students frequently find that their school work is handicapped because of personal, social or academic problems interfering with their progress.

Counsel, by a training specialist of the Veterans Administration who maintains an office in the School, is given veterans attending the School under the "G. I. Bill."

PART-TIME EMPLOYMENT — As the City of Milwaukee is an industrial and marketing center, opportunities for part-time work are more numerous than in many college communities. The School's location in the heart of downtown Milwaukee provides part-time work opportunities within walking distance of the School.

SCHOLARSHIPS — A $15,000 fund has been set aside by the Milwaukee School of Engineering for a number of scholarships to assist deserving students of good character in defraying the cost of tuition.

STUDENT LOANS — A $5,000 Student Loan Fund has been established by the School to aid students in personal financial problems. This fund is used for short-term emergency loans only.

HOUSING — The Housing Secretary maintains an active file of available apartments, rooms, and private homes to aid the new student in finding the type of living quarters desired.

STUDENT PLACEMENT — Full time employment service is maintained by the Relations with Industry Division to aid graduates in finding that all-important 'first job' in industry. The Division's constant contact with industry, both locally and nationally, makes it an effective medium of contact between the prospective employer and the prospective employee.

Location

As the metropolis of Wisconsin, on the shores of Lake Michigan, Milwaukee is a cosmopolitan community of more than 750,000 persons. Besides serving as the home of many of the nation's leading industries, the city boasts unusual recreational facilities, a fine transportation system, a population predominantly home-owning, and diversified program of cultural activities. Milwaukee is well served by rail, water, highway, and air transport.

Radio and Television

Radio and television comprise the bulk of the vast fields of electronics. Radio, being the oldest branch, has found more diverse applications than has television at the moment. While the popular concept of the industry views it as an entertainment medium, the commercial and industrial applications account for the greatest revenue.

Television, on the other hand, is today's infant colossus of industry. Never before in the history of our country has an industry grown to such proportions in so short a span of time. This has been mainly due to the fact that TV was well developed before it was offered on the domestic market.

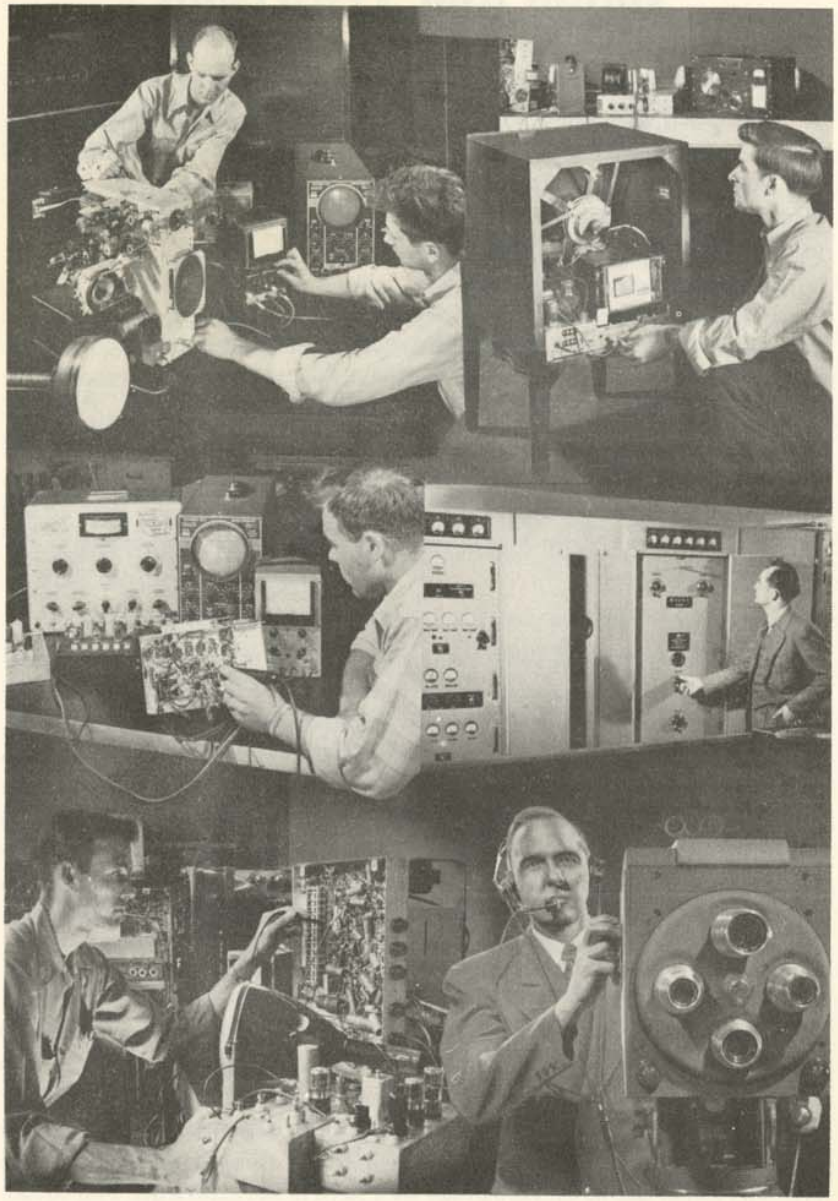
At present primarily an entertainment medium, it has, however, already developed some commercial applications. Used to instruct large groups of interns in surgery and medical practice, its future in the field of education can be tremendous. Where radio-active substances and intense heat do not permit the presence of the human body, TV becomes the technologist's 'eye' for close observation.

Radio

In the early years of radio, sets could be constructed in the home workshop by any person reasonably handy with tools. Even the common five-tube superheterodyne was relatively simple to construct for the amateur craftsman. However, as the multi-tube sets became more popular, and with the addition of Frequency Modulation, radio construction and servicing grew away from the home workshop. Today the radio serviceman must have a solid technical knowledge to properly align and service the more complex radio sets now on the market. The higher frequencies of FM broadcasting pose many more technical problems in reception than confronted the old AM radio mechanic. FM is the connecting link between AM-radio and TV.

Television

The need for television servicemen today is equaled only by the same need when the first radios were marketed. The radio service technician has a foundation on which he may build the skill required in handling the new equipment needed in television service. But he will find that he needs a thorough review of many of the fundamentals which have become more critically important in television than they were in his experience with broadcast receivers. Half-way measures are as good as none in television servicing. Fundamental knowledge, based on a sound technical background, is a 'must'.



Radio and Television

The Institute of Electrotechnics

The history of wireless and radio at the Milwaukee School of Engineering goes back to 1903, the year of the School's founding, only six years after Marconi took out patents on his system of wireless telegraphy. It was in that year that the School's oldest division, the Institute of Electrotechnics, was started. Composed of two branches, Power and Electronics, the Institute has 47 years of experience and research behind its curriculum. The Electronics branch of the Institute is further divided into two sections, Radio and Television Technician and Industrial Electronics Technician.

Well-rounded Curriculum

The Radio and Television Technician Curriculum at MSOE is taught in electronics laboratories equipped with the most modern facilities available. Here the student works with testing equipment such as oscilloscopes, meters and signal generators as if he were actually in the field. Commercial radio and television receivers of the various manufacturers are thoroughly studied. Instruction is given by men who have had practical experience in radio and television as well as formal training in education.

Located in Milwaukee is one of the nation's most modern telecasting stations and many commercial radio broadcasting stations. At points throughout the curriculum, students are taken on field trips through these stations where they see monitoring equipment, cameras, control panels and other complex apparatus used in telecasting and broadcasting. Much of this equipment is covered in the fifth term of the Radio and Television Technician Curriculum.

The "Unit Chassis System"

One of the highlights of the Radio and Television Technician Curriculum is the "Unit Chassis System" of teaching television receivers, as developed at MSOE. This system 'breaks down' the TV receiver by stages — each stage constructed on a separate chassis. The student studies a stage at a time. When all chassis are electrically connected, they result in a complete, operating television receiver. Thus, the student learns intimately the relationship, location, and function of every component in a TV receiving set. This intimate knowledge of the TV receiver enables the student to quickly and accurately analyze the symptoms displayed by a faulty set.

Student Operated Radio Station

Students interested in radio broadcasting take part in the MSOE Amateur Radio Club, operating W9HHX, a 1000 watt amateur radio station located on the Milwaukee School of Engineering campus. A member of the American Radio Relay League, the club is in constant contact with amateur stations all over the world.

Upon completion of the 18 month Radio and Television Technician Curriculum, the graduate receives a Radio and Television Technician Certificate. If he so desires, he may continue his study in the MSOE College of Electrical Engineering for an additional 24 months to earn a Bachelor of Science degree in Electrical Engineering, electronics major.

Curriculum of the Radio and of the Institute

(For advanced credit for any

See Supplement

Radio and Television Technician Curriculum

Eighteen Months (6 *Terms,* 12 *Weeks each Term*)

TERM I

Symbol		Periods Per Week	Subject Title	Periods Per Term
Eltn	21C	5	DC Circuits and Magnetism	60
Eltn	41C	4	DC Circuits Laboratory	48
Shop P.	01A	4	Electrical Shop	48
Math	8C	5	Advanced Algebra	60
Draft	41C	4	General Engineering Drawing	48
Engl	21C	5	Technical English, Rhetoric	60
				324

TERM II

Eltn	22C	4	AC Circuits, Transformers and Transmission	48
Eltn	42C	4	AC Circuits Laboratory	48
Math	9C	5	College Algebra	60
S.R.	21C	1	Elementary Slide Rule Theory and Practice	12
Draft	42B	10	Engineering Drawing	120
Engl	22C	5	Technical English, Basic Composition	60
				348

TERM III

Eltn	23C	5	Principles of Electronics and Radio	60
Eltn	43C	4	Electronics and Radio Laboratory	48
Shop	02A	4	Hand Tools and Small Power Tools	48
Math	10C	5	Plane Trigonometry	60
S.R.	22C	1	Advanced Slide Rule Theory and Practice	12
Draft	43C	5	Engineering Drawing	60
Engl	23C	5	Technical English, Technical Composition	60
				348

Television Technician Section of Electrotechnics

subject, see "ADMISSIONS," page 5.)

TERM IV

Symbol		Periods Per Week	Subject Title	Periods Per Term
Eltn	24C	5	Principles of Radio Servicing (AM)	60
Eltn	44C	10	Radio Servicing Laboratory (AM)	120
Math	11C	5	Analytical Geometry	60
Phy	22C	4	Physics of Heat	48
Phy	42C	4	Physics of Heat Laboratory	48
				336

TERM V

Eltn	27A	5	AM Transmitters and FCC Regulations	60
Eltn	29A	3	Control Room and Studio Procedures	36
Eltn	30A	2	Ultra-High Frequency Techniques	24
Draft	45C	5	Radio and Electronic Circuit Drawing	60
Phy	23C	4	Physics of Light and Sound	48
Phy	43C	4	Physics of Light and Sound Laboratory	48
Engl	25C	5	Practical English of Business	60
				336

TERM VI

Eltn	26A	5	FM and Television Receivers	60
Eltn	46A	10	FM and Television Receivers Laboratory	120
Eltn	28A	5	FM and Television Transmitters	60
I Com	20A	4	Industrial Organization	48
Law	021C	3	Contract Specifications	36
				324

Upon completion of this course, the graduate receives a Radio and Television Technician Certificate. If he so desires, he may continue his study in the MSOE College of Electrical Engineering for an additional 24 *months to obtain a Bachelor of Science degree, electronics major.*

The Radio and Television Curriculum

Beginning with the study of direct current and alternating current circuits, the student receives the essential technical knowledge required to analyze and solve such circuits as are used in electronic equipment. From the very first week of the Radio and Television Technician Curriculum at MSOE the student receives laboratory practice where he learns laboratory techniques and the correct use of electrical instruments. Advancing through the curriculum, the student learns the fundamental principles of electronics and basic concepts of the vacuum tube; the theory and operation of AM radio receivers. In the Radio Servicing Laboratory, the proper care and use of shop test equipment and the use of shop tools are taught. Each student constructs a five-tube AC/DC superheterodyne receiver. In the construction and alignment of this receiver, the student gains experience and practice in radio servicing methods. Further radio servicing experience is gained by assigning the student to servicing sets which are not in working order. Emphasis is placed on both classroom demonstrations and practical laboratory work which simulates actual radio shop practice.

Following the study of radio receivers, the course covers the theory and operation of amplitude modulated radio transmitters. This phase of the curriculum prepares the student for the Federal Communications Commission commercial license examination. At the same time the student is given the problems and techniques encountered in accepted operating practice in the control room of broadcasting stations, including master controls, remote controls, and pick-up from remote broadcasting. The course in Ultra-High Frequency Techniques introduces the student to the techniques required to work successfully with ultra-high frequency equipment which he will encounter in FM and Television.

FM and Television

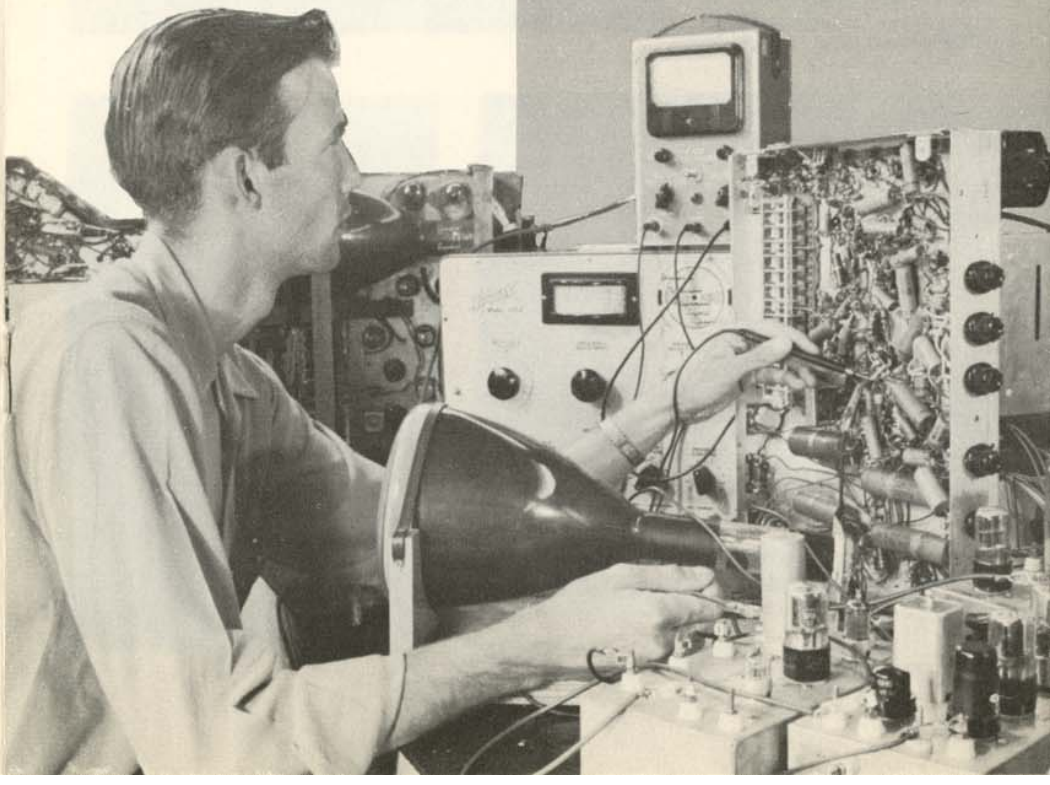
The theory and circuits of frequency modulation and television receivers are thoroughly covered. Here the circuits of most of the leading TV receivers are discussed. At this point in the curriculum, the student is first introduced to the Unit Chassis System of television instruction as is described earlier in this catalog. In the FM and Television Receivers Laboratory, the student practices complete alignment procedures on commercial television receivers using representative circuits from receivers currently manufactured and marketed, Here the use of the oscilloscope, vacuum-tube voltmeter and sweep generator prove their importance to TV servicing. Also at this time in the curriculum the student is given the basic principles of the theory and operation of frequency modulated and TV transmitters. The television transmitting equipment that supplements the actual transmitter apparatus is also covered in the program. Included are the television camera and the associated monitors and controls, frequency control circuits and antennas.

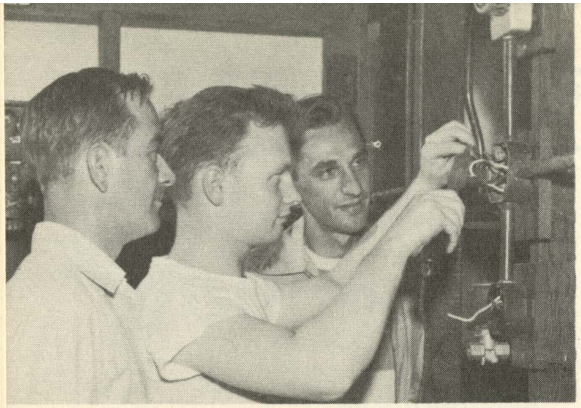
Related Subjects

Subjects in the basic sciences, humanities and 'tool subjects' such as mathematics and drawing, complimentary to the technical subjects studied, round out the curriculum to provide the student with a firm foundation that he may take his place as an expressive, productive and self-reliant technician in the multifarious fields of communications electronics.

raining he V echnician

As is shown pictorially on the following pages, the Radio and Television curriculum at the Milwaukee School of Engineering not only gives the student a sound technical and practical education, but prepares him with the necessary knowledge of business and psychology to enable him to competitively take his place in today's rapidly expanding TV service field.



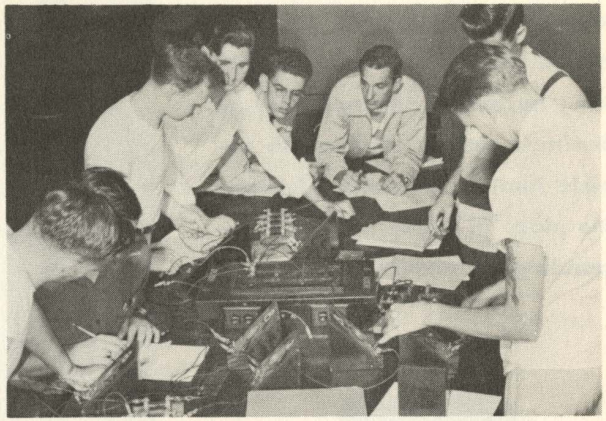


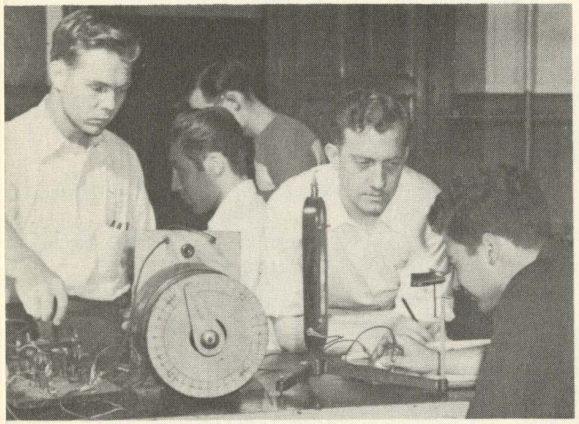
The first two terms of this course give the student a solid foundation in the fundamentals of electricity as well as the necessary mathematics and allied subjects upon which he will build his future studies.

▲ 1. In the Electrical Shop (01A) the student gains a practical knowledge of electrical wiring by making actual installations.

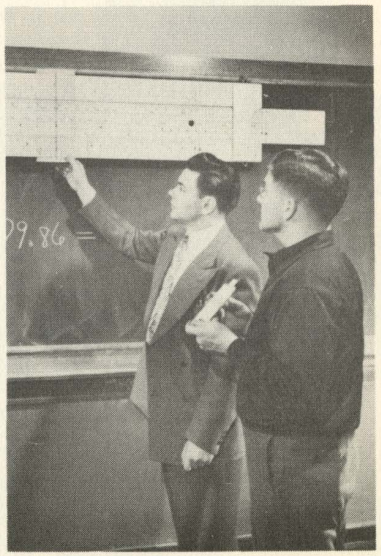
2. The fundamentals of electrical measurements in DC ▶ circuits are covered in the DC Circuits Laboratory through a carefully planned series of laboratory experiments.

3. The theory of AC circuits is proven in the AC Circuits Laboratory where students perform experiments illustrating the proper use of test equipment and ▼ efficient testing procedure.

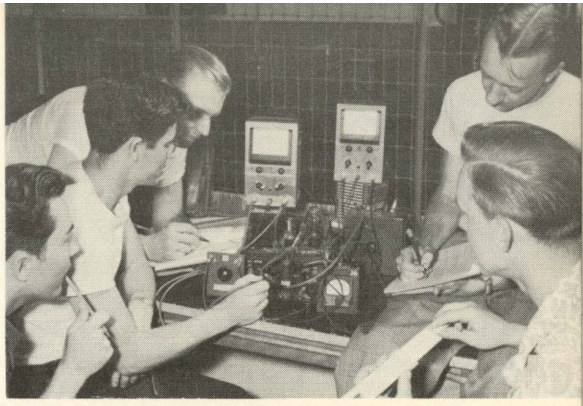




4. In the interest of efficiency, ease and speed of calculation, the student is taught the use of the slide rule. ▶



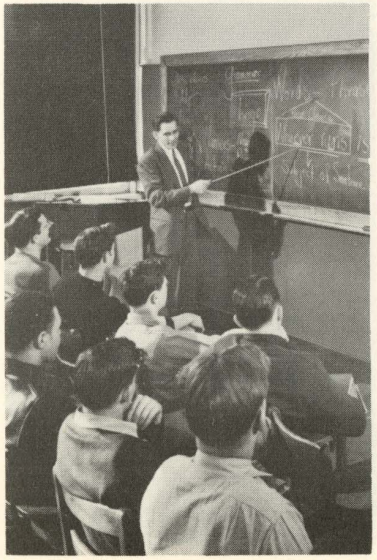
In his next two terms the student learns the principles of electronics and radio and enters radio servicing. He is learning the practical applications of theory through laboratory classes.



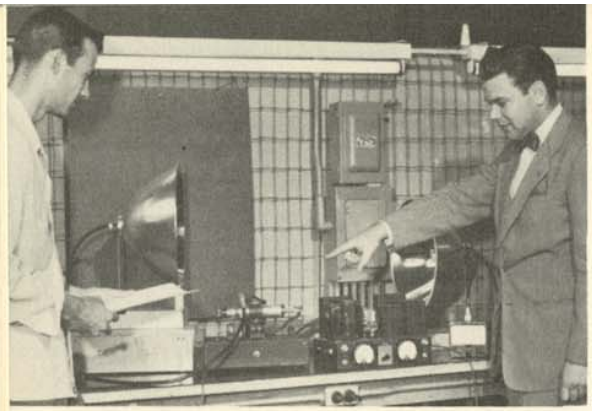
▲ 5. Here the students perform experiments illustrating the fundamentals of vacuum tube theory in the Electronics and Radio Laboratory (Eltn 43C).

◀ 6. Among the many duties of the technician in industry is that of reading and making engineering drawings. Shown here is an Engineering Drawing (Draft 43C) class of third term students.

7. Following the building of a five-tube superheterodyne AM receiver, the student learns the complete shop methods of radio servicing. ▼



◀ 8. The significance of English as an important factor for success in industry is not overlooked. Expression in technical writing is stressed.



Nearing the completion of his course, the student is now concerned with AM transmitters and FCC regulations, Ultra-high frequency equipment and control room and studio procedures. His last term is spent in the precise theory and servicing of FM and TV receivers.

▲ 9. Many critical factors enter the work with Ultra-high frequencies that were not present in the study of the lower frequencies. Here the student learns UHF techniques.

10. In Industrial Organization (1 Com 20A) the student learns the organization pattern of business and the importance of the individual in business. ▶

11. To properly understand television, a knowledge of the characteristics of light and sound is essential. Here students in the Physics of Light and Sound Laboratory (Phy 43C) are shown using the spectrograph. ▼

12. Through the study of component units of the TV receiver, the student learns the alignment and servicing techniques of commercial television receivers. ▶

"Laboratory assistants and engineering assistants are, in many cases, men trained in technical institutes. In these jobs, a practical background in radio and television repair or servicing would prove inadequate without education in theory and principles of electronics, of tubes and of circuits."

DR. W. R. G. BAKER
Vice-president of the General Electric Company and General Manager of the Electronics Department
Director of Engineering for RTMA
Fellow of IRE; Fellow of AIEE

"Television, already one of our Nation's largest industries, is less than 3 years old. Its potential is so great that one dares not attempt to evaluate it. TV's greatest handicap so far has been the critical shortage of technicians properly trained and qualified to install and service the highly complex circuits and mechanism. TV immediately needs upwards of 100,000 trained technicians. Men having the proper technical training will have, in TV and its associated arts, industrial electronics and communications, an extremely bright future of almost unlimited scope."

SANFORD R. COWAN
Editor and Publisher
"Radio-TV Service Dealer" and "CQ—The Radio Amateur's Journal"
Member: Advisory Committee, New York Board of Education Vocational Schools; Associate Member, IRE

"The Most important national servicing problem we have is the need for more technically trained television servicemen. This industry has grown so vast and has spread so quickly that there is a dire need for more competent men to take care of the millions of sets that are already in use — to say nothing of the additional millions to come."

A. T. ALEXANDER
Service Manager
Motorola Incorporated, Chicago
Chairman of the Service Committee of the RTMA

The Industrial Picture

The radio-television industry today embraces three interdependent branches, which employ technicians possessing widely varied abilities. These branches are:

1. Manufacturing and merchandising of transmitter and receiver apparatus.
2. Commercial communications.
3. Transmitting to the public.

MANUFACTURING AND MERCHANDISING

The manufacturing and merchandising branch deals with the manufacture, distribution and servicing of equipment used in the other two divisions. Basically, business is divided in two broad fields, manufacturing and retailing. In the conventional business pattern both of these fields are divided in nine traditional functions, plus management. As this booklet is not directed to an individual already in the field, we will skip over some of the important functions, such as record maintenance, product design, purchasing, personnel relations, public relations, finance and character, for the moment, and concentrate on production and sales, as they are the most likely places for a beginning.

PRODUCTION

In manufacturing, assembly, installation, and testing are usually assembly-line processes open to the semi-skilled service level individual. The more skilled technician finds his place in the experimental laboratories and engineering departments where his knowledge and skills may be put to direct use in a variety of ways, from model-making, testing and drafting to straight research work. Or, the skilled technician, after serving a period in the service level job, may step into a foreman's or supervisory position.

To the retailer, production means the installation, service, maintenance and operation of manufactured equipment. The first step in this production process is called application engineering, particularly for the commercial and industrial applications. It involves selection of the kind and size of equipment best suited to the buyer's requirements. Installations require wiring diagrams,

physical layouts, and estimates of material and labor. It is one of the duties of the applications engineer to make these layouts and estimates. This phase of retailing belongs to the engineer and technician exclusively.

The related fields of installation and service likewise offer premiums for technical and engineering knowledge. Most manufacturers supply detailed instructions which can readily be interpreted by a trained man of ordinary intelligence. However, the rewards are always greatest for the men who know the job well enough to organize it properly, to execute it in a workmanlike manner, and to be sure that it operates as was intended by the engineers who designed and produced it.

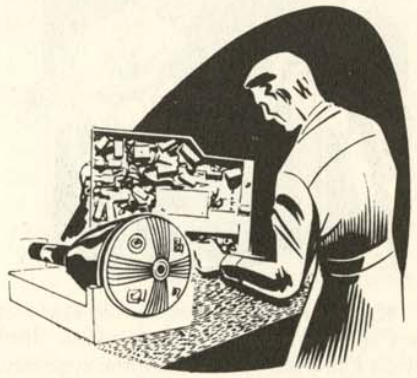
A serviceman is one who is skilled in the art of repair and maintenance. His primary concern is to keep the apparatus in working condition, or if it fails, to see that it is soon in operating condition again. He can usually complete his training and be in a wage earning position within a year. The financial security is good, and there are many opportunities for the serviceman to become his own boss.

The technician is one who acts as a liaison agent with engineers. He is required to have a practical knowledge of scientific methods and practices so that he can understand the language of engineering and be able to interpret directions. The technical draftsman translates the engineer's sketches into blueprints; the technical assistant erects a working model; and the laboratory assistant aids the engineer or scientist in carrying out routine research duties. The technician, by the nature of his work, does not require the extensive education which the engineer does. Several times as many servicemen are needed as technicians, and several times as many technicians are needed by industry than engineers.

A man may launch his career in the television service field by first working as a *Television Installation Man.* He performs such duties as setting-up, installing, testing, and adjusting the television antenna and receiver in the customer's home or establishment, and explains the operation and the care of the set to the customer.

Maintenance service is a different matter. Relatively few of the users of electronic devices have the technical knowledge required to maintain and adjust them. Consequently, the satisfaction and safety of the user is dependent almost entirely upon the knowledge and skill of the men who service his equipment.

Radio Servicemen repair home and auto radios. In addition, they may also install and service other electronic equipment, such as inter-office communications and public address systems and warning devices. Sometimes radio repairmen sell and service other electrical appliances. A majority of those working on AM-FM sets are self-employed; some are employed by large repair shops, radio stores, garages, wholesale distributors, manufacturers of electronic equipment and other types of concerns.



The Television Service and Repairman also performs most of his duties at the

service shop. He assembles, tests, aligns, adjusts, and repairs the television receiver; duties which require a technical knowledge of television and a working knowledge of the complex test equipment used to intelligently service the set.

Many television technicians are employed by large companies to serve as assistants to engineers and scientists in experimental laboratories. Other television technicians find jobs in radio and television manufacturing plants which produce radio and television sets and equipment. These positions usually deal with the layout and supervision of production, and inspection and testing of manufactured equipment. These positions require men who have a mathematical and drafting background as well as a technical knowledge of the field.

SALES

Knowledge requirements for salesmen are similar to those of technicians. Both must know the operation of the apparatus with which they work. The technician must have a more detailed knowledge, but the salesman who begins with a technician's knowledge builds on a sound foundation. Research and production engineering are begun with the hope of making sales. There is no job anywhere for engineers, technicians, installers, or servicemen unless salesmen sell goods. Consequently, the rewards to successful salesmen are high, and many graduate into the ownership of their own businesses or into responsible positions in management.

MANAGEMENT

Every business you can name and every industry you can think of represents the development of an idea. Someone had courage to believe that he could make or sell goods or services which people want. The idea usually starts with a single individual who risks his savings and invests his time and effort in the project. When he begins to employ others to help him make and sell these goods and serve his customers, he becomes a manager, for it is management's job to establish the policies of the business, assign tasks to various employees, and see that said tasks are executed. To permit more rapid expansion, the businessman may persuade friends and others to invest their savings in his enterprise. He promises reasonable compensation for the use of their savings and for the risks they run. It is every man's desire to own his own business, to be his own 'boss'. While in the majority of cases the beginner does not start at the top by owning his business, such is not entirely impossible. Under favorable circumstances, many technically trained men, with only a minimum of work experience, have successfully started their own enterprises. This is particularily true in the small communities where there are few technically trained specialists.

COMMERCIAL COMMUNICATION

In aviation and the marine field, radio has become a fixture, not only in communications, but in navigation systems as well. The taxicab field has adapted radio for dispatching in most cities, while trucking and bus companies are also finding it useful. The FCC has opened space in the frequency spectrum to facilitate public safety radio services such as police, fire, forestry-conservation, state highway maintenance, and special emergency services which get 170 frequencies. Another large user of the two-way radio communications is the public utility industry.

TRANSMITTING TO THE PUBLIC

While it is the musician, the singer, the comedian, and the announcer who receive the applause of the listener, it is the technical man who keeps the program "on the air." In reality, the engineer is the key man in transmitting to the public — just as he is with the manufacturing division of the industry. Since these men contribute the "heart" of radio, it is well to have some understanding of the functions they perform.

The engineering set-up in a large studio is usually divided into groups; such as master control, studio engineering, field engineering, maintenance and construction, and transmitters. The staff of a large station averages close to 100 employees while a small station will employ about six workers.

OPERATING ENGINEER

A great proportion of the radio engineers in broadcast work are not actually working on radio, but are telephone engineers. Big city studios are usually in business districts, while the powerful transmitters are located outside the city and are connected by telephone lines. The engineers controlling the programs originating in the cities are engaged primarily in monitoring high fidelity telephone equipment and transmitting programs over thousands of miles of telephone circuits that carry them to the radio or television transmitters on the network.

RADIO AND TELEVISION OPERATOR

The bona fide operators in the group of radio engineers are the transmitter men who man the high power stations in the suburbs, checking and repairing high voltage equipment. They are usually recruited from previous service in maritime or commercial divisions, and are the only ones employed by the network who are required to be government-licensed radio engineers.

The broadcasting operators best known to the public are the studio operators who may be seen behind the glass partitions of the control room in the broadcasting station. Their duty is to achieve the timing, blending of voices, orchestra, and other sounds that go to make a perfect production. Operators in the communications branch of radio, point-to-point, maritime, and coastal services, are required to have government licenses, which are obtained through study and by passing an FCC examination satisfactorily. This is most easily accomplished by a planned course of study. Their duties are concerned solely with transcribing messages, photographs, etc., and the maintenance of equipment necessary for those duties.

OCCUPATIONAL CHART

Educational Advancement

Occupational Advancement

TECHNICIAN LEVEL

Radio and Television Technician
18 months total

Studio Engineer (radio broad)	DOT 0-61.40
Transmitter Technician (radio broad)	DOT 0-61.30
Television Service and Repairman (any ind)	DOT 5-83.416
Television Installation Man (any ind)	DOT 5-83.417
Radio Communication Maintenance Man (tel & tel)	DOT 5-83.446
Radio Research and Development Mechanic (tel & tel)	DOT 5-00.912
Radio Communication Technician (tel & tel)	DOT 5-83.445
Radio Interference Investigator (lt, ht, & power)	DOT 5-83.367
Electrician, Radio (any ind)	DOT 5-83.445
Radio Equipment Assembler (radio mfg)	DOT 4-98.050
Radio Mechanic (any ind) II	DOT 5-83.447
Radio Repairman (any ind) I	DOT 5-83.411

ENGINEERING LEVEL

Electrical Engineering
3 years

Radio Engineer (radio broad)	DOT 0-17.01
Audio Engineer (prof & kin)	DOT 0-17.01
Radio Television Design Engineer (prof & kin)	DOT 0-17.01
Radio Television Research Engineer (prof & kin)	DOT 0-17.01
Television Engineer (prof & kin)	DOT 0-17.01
Telephone Engineer (tel & tel)	DOT 0-17.01
Telegraph Engineer (tel & tel)	DOT 0-17.01
Transmission Engineer (tel & tel)	DOT 0-17.01

Job Opportunities

The occupational chart on the opposite page has been prepared by the Milwaukee School of Engineering faculty to aid students in visualizing the occupations to which individuals may be promoted after a period of training and preparation.

Reading down from the top of the chart, there are listed occupational objectives corresponding to the level of study; namely, technician and engineering. The occupations listed are among those in which Alumni of the Milwaukee School of Engineering are engaged. Appearing to the right of the occupational titles are reference numbers as listed in the 1949 Dictionary of Occupational Titles (Second Edition) as published by the United States Government.

Due to the multitude of occupational opportunities that the Radio-Television Industry offers today, it would be impossible to give a complete listing in the space allotted. Those occupations shown are the most likely beginning positions in the industry. There are a score of positions open to to the technician and engineer in the manufacturing phase of the industry alone; i. e., service manager, production manager, service engineer, sales, draftsman, safety engineer, supervisor in radio and television assembly, laboratory technician, etc.

The course given at the Milwaukee School of Engineering in Radio and Television prepares the graduate for those opportunities as are shown on the technician level. The course also prepares the student for examination for a Federal Communications Commission license to operate a broadcasting station. Upon satisfactory completion of the course most men enter the field, but those wishing to continue their education may do so by further study for an additional two calendar years in the College of Electrical Engineering of the School, earning a Bachelor of Science Degree in Electrical Engineering, electronics major. Thus he would be prepared for those occupational objectives as shown on the engineering level of the occupational chart.

Inasmuch as we are discussing "job opportunities," we cannot overlook another employer — our governmental agencies, in both civilian and national defense occupations. There are many opportunities awaiting the trained technicians in the municipal, state and federal governmental agencies.

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City _____ State _____

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College of Electrical Engineering
Two curricula leading to the Degree of Bachelor of Science.
Electronics . . . . . 36 months
Electrical Power . . . . . 36 months

Institute of Electrotechnics
Practical Electricity . . . . . 6 months
Electro Technician . . . . . 12 months
Electronics Technician . . . . . 12 months
Radio and Television Technician . . . . . 18 months

Refrigeration, Heating and Air Conditioning Institute
Refrigeration Service . . . . . 6 months
Refrigeration and Heating Service . . . . . 12 months
Refrigeration, Heating and Air Conditioning Technician . . . . . 24 months

Welding Institute
Practical Welding . . . . . 6 months

Industrial Research Institute
Applied research in electrical engineering and allied fields.

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Supplement

to

Milwaukee School of Engineering

BULLETIN

Vol. 2 No. 11 *Radio and Television Issue* **Sept. 10, 1950**

Upon the recommendation of the Institute of Electrotechnics Advisory Committee, and in accordance with the best industrial and academic standards, terminal certificates are available upon completion of either the Radio Technician or Radio and Television Technician curricula. The following curricula supersede those shown on pages 10 and 11.

Radio Technician Curriculum

TERM I:

Symbol	Subject Title	Periods Per Week	Lecture	Lab.	Credit In Quarter Hours
El 21D	DC Circuits and Magnetism	4	4	0	4
El 41D	DC Circuits Laboratory	4	1	3	2
Shop 01B	Electrical Shop	4	1	3	2
Math 10C	Plane Trigonometry	5	5	0	5
Engl 21D	English, Rhetoric	3	3	0	3
Draw 41A	General Engineering Drawing	3	0	3	1
SR 21C	Elementary Slide Rule	1	1	0	0
FL 21A	Freshman Lecture	1	1	0	0
	Totals	25	16	9	17
Math 8C	Algebra	5	5	0	0

(Offiered to students who need preparation for College Algebra)

TERM II:

El 22D	AC Circuits and Transformers	4	4	0	4
El 42D	AC Circuits Laboratory	4	1	3	2
Shop 02B	Hand and Power Tools	4	1	3	2
Math 9C	College Algebra	5	5	0	5
Engl 22D	English, Basic Composition	3	3	0	3
Draw 42A	Engineering Drawing	6	0	6	2
SR 22C	Advanced Slide Rule	1	1	0	0
	Totals	27	15	12	18

TERM III:

Eltn 23D	Principles of Electronics	5	5	0	5
Eltn 43D	Electronics Laboratory	4	1	3	2
Math 11C	Analytic Geometry	5	5	0	5
Engl 23D	English, Composition	3	3	0	3
Draw 43A	Engineering Drawing	6	0	6	2
I Com 21B	Applied Psychology	3	3	0	3
	Totals	26	17	9	20

TERM IV:

Eltn 24D	Radio Servicing Theory	5	5	0	5
Eltn 44D	Radio Servicing Laboratory	10	1	9	4
Engl 25D	English, Business	3	3	0	3
I Com 22B	Industrial Organization*	4	4	0	4
I Com 23B	Technical Selling†	3	3	0	3
	Totals	25	16	9	19
Math 21C	Differential Calculus*	4	4	0	4
Draw 44A	Descriptive Geometry†	6	0	6	2

*†Students with grade point average 1.25 or higher at end of Term III and who plan to continue engineering education beyond Term IV, shall elect Differential Calculus in place of Industrial Organization, and Descriptive Geometry in place of Technical Selling.

Radio and Television Technician Curriculum

TERM I:

Symbol	Subject Title	Periods Per Week	Lecture	Lab.	Credit In Quarter Hours
El 21D	DC Circuits and Magnetism	4	4	0	4
El 41D	DC Circuits Laboratory	4	1	3	2
Shop 01B	Electrical Shop	4	1	3	2
Math 10C	Plane Trigonometry	5	5	0	5
Engl 21D	English, Rhetoric	3	3	0	3
Draw 41A	General Engineering Drawing	3	0	3	1
SR 21C	Elementary Slide Rule	1	1	0	0
FL 21A	Freshman Lecture	1	1	0	0
	Totals	25	16	9	17
Math 8C	Algebra	5	5	0	0

(Offered to students who need preparation for College Algebra)

TERM II:

El 22D	AC Circuits and Transformers	4	4	0	4
El 42D	AC Circuits Laboratory	4	1	3	2
Shop 02B	Hand and Power Tools	4	1	3	2
Math 9C	College Algebra	5	5	0	5
Engl 22D	English, Basic Composition	3	3	0	3
Draw 42A	Engineering Drawing	6	0	6	2
SR 22C	Advanced Slide Rule	1	1	0	0
	Totals	27	15	12	18

TERM III:

Eltn 23D	Principles of Electronics	5	5	0	5
Eltn 43D	Electronics Laboratory	4	1	3	2
Math 11C	Analytic Geometry	5	5	0	5
Engl 23D	English, Composition	3	3	0	3
Draw 43A	Engineering Drawing	6	0	6	2
I Com 21B	Applied Psychology	3	3	0	3
	Totals	26	17	9	20

TERM IV:

Eltn 24D	Radio Servicing Theory	5	5	0	5
Eltn 44D	Radio Servicing Laboratory	10	1	9	4
Engl 25D	English, Business	3	3	0	3
I Com 22B	Industrial Organization	4	4	0	4
I Com 23B	Technical Selling*	3	3	0	3
	Totals	25	16	9	19
Draw 44A	Descriptive Geometry*	6	0	6	2

*Students who intend to continue study toward Bachelor of Science Degree in Electrical Engineering after completing the Radio and Television Technician Course will elect Descriptive Geometry in place of Technical Selling.

TERM V:

Symbol	Subject Title	Periods Per Week	Lecture	Lab.	Credit In Quarter Hours
Eltn 27A	AM Transmitters, FCC Regulations	5	5	0	5
Eltn 47A	Transmitter Laboratory	7	1	6	3
Eltn 29A	Control Room Procedures	3	3	0	3
Eltn 30A	Ultra High Frequency Techniques	2	2	0	2
Eltn 31A	Pulse Systems	3	3	0	3
Eltn 32A	Frequency Modulation	2	2	0	2
I Com 24B	Merchandising and Advertising	4	4	0	4
	Totals	26	20	6	22

TERM VI:

Eltn 26B	Television Receivers	5	5	0	5
Eltn 46B	Television Receivers Laboratory	10	1	9	4
Eltn 28A	FM and Television Transmitters	5	5	0	5
Law 20A	Business Law	3	3	0	3
I Com 25A	Accounting Fundamentals*	4	4	0	4
	Totals	27	18	9	21
Math 21C	Differential Calculus*	4	4	0	4

Curricula of Milwaukee School of Engineering

College of Electrical Engineering

Two curricula leading to the Degree of Bachelor of Science.

Electronics	36 months
Electrical Power	36 months

Institute of Electrotechnics

Electrical Preparatory	3 months
Electrical Service	6 months
Electro Technician	12 months
Electronics Technician	12 months
Radio Technician	12 months
Radio and Television Technician	18 monhts

Refrigeration, Heating and Air Conditioning Institute

Refrigeration Service	6 months
Heating Service	6 months
Air Conditioning Technician	12 months

Welding Institute

Welding Operator	6 months
Welding Technician	12 months

Industrial Research Institute

Applied research in electrical engineering and allied fields.

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